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NATIONAL DAM SAFETY PROGRAM. LOTTES DAM (MO 30309) LOWER MISSIS--ETC(U)
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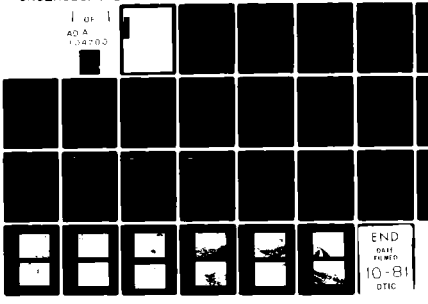

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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LOTTES DAM
WAYNE COUNTY, MISSOURI

MISSOURI INVENTORY NO. 30309

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: ST. LOUIS DISTRICT CORPS OF ENGINEERS
FOR: GOVERNOR OF MISSOURI

AUGUST 1979

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam	Lottes Dam
State Located	Missouri
County Located	Wayne County
Stream	Unnamed tributary to West Fork Creek
Date of Inspection	17 May 1979

Lottes Dam was inspected by an interdisciplinary team of engineers from the Memphis District, U.S. Army Corps of Engineers. The purpose of the inspection was to make an assesment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assesment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten the life and property of approximately 7 families downstream of the dam.

The inspection and evaluation indicate that the spillway does not meet the criteria set forth in the guidelines for a dam having the above mentioned size classification and hazard potential. For its size and hazard category, this dam is required by the guidelines to pass from one-half PMF to PMF. However, considering the high-hazard potential to life and property of approximately seven families downstream of the dam, the PMF is considered the appropriate spillway design. The emergency spillway will only pass 25 percent of the PMF before the dam embankment is overtopped. Because the spillway will not pass 1/2 of the PMF without overtopping but will pass the 10-year frequency flood, the dam is classified as "unsafe non-emergency." The spillway will pass the 100-year flood without overtopping, which is a flood that has a 1 percent chance of being exceeded in any given year. There are no other hydrologic or hydraulic deficiencies.

Other deficiencies visually observed by the inspection team were trees and trash blocking the emergency spillway, and deep erosion in the emergency spillway outfall; trees and bushes on the downstream embankment slope; erosion gullies on the downstream embankment slope; and seepage. Also, the trash rack and 13 inches of bituminous coated corrugated metal pipe were severed from the vertical inlet pipe. Another deficiency found was the lack of seepage and stability analysis records.

It is recommended that the owner take action to correct or control the deficiencies described. Corrective works should be in accordance with analyses and design performed by an engineer experienced in the design and construction of dams.

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SUBMITTED BY: SIGNED — 19 SEP 1979
Chief, Engineering Division — Date

APPROVED BY: SIGNED — 19 SEP 1979
Colonel, CE, District Engineer — Date

Overview of Lottes Lake

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LOTTES DAM - ID NO. 30309

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer for the St. Louis District, Corps of Engineers, directed that a safety inspection of the Lottes Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth structure built in a narrow valley in the uplands which border the Mississippi Embayment. Topography adjacent to the valley is rolling to steep. Soils in the area are formed of red silty clays with fragments of dolomite and chert. Topography in the vicinity of the dam is shown on Plate 2.

(2) A vertical inlet constructed of 10 ft. of 30 inch bituminous coated corrugated metal pipe (CMP) junctioned with 130 ft. of 24-inch bituminous coated corrugated metal pipe is the primary means of discharge. An emergency spillway is cut in the left abutment. The emergency spillway is a trapezoidal section with a bottom width of approximately 50 feet and side slopes of approximately 1V on 3.5H.

(3) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the west central portion of Wayne County, Missouri, as shown on Plate 1. The lake formed by the dam (as presented on Plate 2) is shown on the Shook, Missouri Quadrangle sheet in Section 29; Township 28 North, Range 7 East.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1 c. above. Based on these criteria, this dam and impoundment is in the small size catetory.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c. above. Based on referenced guidelines, this dam is in the High Hazard Classification.

e. Ownership. This dam is owned by Dr. Otto Lottes of 6434 Chippewa in St. Louis, Missouri.

f. Purpose of Dam. The dam forms a 20-acre recreational lake.

g. Design and Construction History. The dam was designed by the Soil Conservation Service of the U.S. Department of Agriculture. Readily available design data were limited to a set of drawings dated 19 May 1967. The drawings consist of a hydraulic and hydrologic design, a location plan, a typical embankment cross-section (see Plate 5), a centerline section through the dam including 6 soil borings (see Plate 4), and cross-sections of the stream channel below the fill. Whether or not slope stability and seepage analyses were performed using suitable loading conditions including earthquake forces is unknown.

The dam was constructed in 1967 by the Teel Construction Company of Butler County, Missouri. The earth embankment was constructed of cherty, silty clays excavated from borrow areas located on ridges in the vicinity of the right abutment. The soil was transported by scrapers and then compacted in lifts by several passings of the scrapers and a dozer. The contract drawings specified a "core trench" with a 12-foot bottom width but the depth and extent of the "core trench" is unknown. A typical embankment cross-section from the 1967 contract drawings showing the primary features of the vertical inlet and the discharge system is presented on Plate 5. Based on the inspection survey an average 1V on 2.75 H downstream slope was used instead of the 1V on 2 H slope specified in the 1967 contract drawings. Also, the elevations and sizes of the existing upstream and downstream berms differ slightly from those shown on the 1967 contract drawings. The existing upstream berm is at El. 534 m.s.l. instead of El. 535.5 m.s.l. as shown on the contract drawings. The existing downstream berm is at El. 523 m.s.l. and is 7 feet wide as compared to El. 521 m.s.l. and 8 feet wide as shown on the contract drawings. Another difference between the actual dam construction and that shown on the 1967 contract drawings is the location of the emergency spillway. The actual location of the emergency spillway is adjacent to the left abutment instead of the right abutment as shown on the contract drawings.

h. Normal Operating Procedure. Normal rainfall, runoff, transpiration, and evaporation all combine to maintain a relatively stable water surface elevation. The emergency spillway was reportedly used only twice. It was used first in the spring of 1974 during an 11 in. rain and the second time occurred in 1976 when the vertical inlet became blocked by leaves. The maximum depth of flow that occurred in the emergency spillway is unknown.

1.3 PERTINENT DATA

a. Drainage Area - 478 acres (Topographic Quadrangle)

b. Discharge at Damsite.

(1) Discharge can take place through a vertical pipe inlet and an emergency spillway.

(2) Estimated experienced maximum flood at damsite - unknown.

c. Elevation (Feet above MSL)

(1) Observed Pool - 535.1
(2) Normal Pool - 535.1
(3) Spillway Crest - 537.3
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - 541.0
(6) Maximum Pool (PMF) - 543.0
(7) Invert of Discharge Pipe at Stilling Basin - 507.7
(8) Streambed at centerline of dam - 504.6
(9) Maximum Tailwater - Unknown

d. Reservoir. Length of maximum pool - 2400± feet.

e. Storage. (Acre - feet)

(1) Observed Pool - 194
(2) Normal Pool - 194
(3) Spillway Crest - 227
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - 317
(6) Maximum Pool (PMF) - 374

f. Reservoir Surface Area (Acres)

(1) Observed Pool - 20.39
(2) Normal Pool - 20.39
(3) Spillway Crest - 22.79
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - 27.14
(6) Maximum Pool (PMF) - 29.96

g. Dam.

(1) Type - earth embankment
(2) Length - 400 ± feet
(3) Height - 36 feet Maximum
(4) Top Width - 14 ± feet

(5) Side Slopes
    (a) Downstream - 1V on 2.75 H
    (b) Upstream - 1V on 3 H
(6) Upstream berm - el. 534 ± feet m.s.l. and 8 feet wide
(7) Downstream berm - el. 523.5 ± feet m.s.l. and 7 feet wide
(8) Impervious core - Unknown
(9) Cutoff - 12-foot wide trench with the depth of the trench unknown
(10) Grout curtain - Unknown

h. Diversion and Regulating Tunnel. None.

i. Primary Discharge System.

(1) Type - An uncontrolled 30-inch diameter CMP junctioned with a 24-inch diameter discharge pipe (see paragraph 1.2 a).
(2) Length of 30-inch diameter pipe - 10 feet
(3) Length of 24-inch diameter pipe - 130 feet
(4) Top elevation of vertical pipe - 535.1 m.s.l.
(5) Invert of discharge pipe at stilling basin - 507.7 m.s.l.

j. Emergency Spillway

(1) Type - Uncontrolled earthen
(2) Width of weir - 50 feet (bottom width)
(3) Length of weir - approximately 150 feet from centerline of spillway
(4) Crest elevation - 537.3 m.s.l.

k. Regulating Outlet. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The dam was designed by the Soil Conservation Service of the U.S. Department of Agriculture. Readily available design data were limited to a set of contract drawings dated 19 May 1967. The drawings consist of a hydraulic and hydrologic design, a location plan, a typical embankment cross-section (see Plate 5), a centerline section through the dam including 6 soil borings (see Plate 4), and cross-sections of the stream channel below the fill. Whether or not slope stability and seepage analyses were performed using suitable loading conditions including earthquake forces is unknown.

2.2 CONSTRUCTION

The dam was constructed in 1967 by the Teel Construction Company of Butler County, Missouri. The earth embankment was constructed of cherty, silty clays excavated from borrow areas located on ridges in the vicinity of the right abutment. The soil was transported by scrapers and then compacted in lifts by several passings of the scrapers and a dozer. The contract drawings specified a "core trench" with a 12-foot bottom width but the depth and extent of the "core trench" is unknown. A typical embankment cross-section from the 1967 contract drawings showing the primary features of the vertical inlet and the discharge system is presented on Plate 5. Based on the inspection survey an average 1V on 2.75 H downstream slope was used instead of the 1V on 2 H slope specified in the 1967 contract drawings. Also, the elevations and sizes of the existing upstream and downstream berms differ slightly from those shown on the 1967 contract drawings. The existing upstream berm is at El. 534 m.s.l. instead of El. 535.5 m.s.l. as shown on the contract drawings. The existing downstream berm is at El. 523 m.s.l. and is 7 feet wide as compared to El. 521 m.s.l. and 8 feet wide as shown on the contract drawings. Another difference between the actual dam construction and that shown on the 1967 contract drawings is the location of the emergency spillway. The actual location of the emergency spillway is adjacent to the left abutment instead of the right abutment as shown on the contract drawings.

2.3 OPERATION

The emergency spillway was reportedly used only twice. It was used first in the spring of 1974 during an 11 inch rain and the second time occurred in 1976 when the vertical inlet became blocked by leaves. The maximum depth of flow that occurred in the emergency spillway is unknown.

2.4 EVALUATION

a. Availability. The only engineering data available were mentioned in paragraphs 2.1 - 2.3 above.

b. Adequacy. The 1967 hydraulic and hydrologic design was inadequate to assess if the dam could pass the probable maximum flood without overtopping. The design presented on the 1967 drawing was for a 50-year frequency storm which is much smaller than the PMF.

c. Validity. The contract drawings appear to be valid except for the differences mentioned in paragraph 2.2 above.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. Visual inspection of Lottes Dam was performed on 17 May 1979. Personnel making the inspection were employees of the Memphis District, Corps of Engineers, and included a geological engineer, a hydraulic engineer, and a soils engineer. Also the owner accompanied the inspection team. Specific observations are discussed below.

b. Dam. No detrimental settlement, cracking, slides or animal burrows were observed in or near the earth embankment. A typical existing cross-section of the embankment is shown on Plate 6. This section is consistent with the cross-section presented in the Soils Conservation Service 1967 drawings (see Plate 5) except the downstream embankment slope is 1V on 2.75 H. Also, the elevations and sizes of the existing upstream and downstream berms differ slightly from those shown on the 1967 contract drawings. The existing upstream berm is at El. 534 m.s.l. instead of El. 535.5 m.s.l. as shown on the contract drawings. The existing downstream berm is at El. 523 m.s.l. and is 7 feet wide as compared to El. 521 m.s.l. and 8 feet wide as shown on the contract drawings. The crest and upstream dam embankment appear to be well maintained. The upstream slope had recently been cleared of small brush growth (see Photo 3). The entire downstream dam embankment is overgrown with trees and bushes (see Photos 4 and 6). The trees were planted after the construction of the dam in 1967.

One erosion gulley, approximately 1.5 feet deep, 2 feet wide and 30 feet long was located on the downstream embankment near the left abutment where the dam intersects natural ground (see Photo 5). The gulley was caused by runoff water flowing from the left abutment area. Another small erosion gulley exists in the right abutment near the crown of the dam (see Photo 16).

Seepage was observed flowing from several locations at the toe of the dam from Sta. 1+60 to Sta. 3+33 (see Plate 3). There was also slight seepage flowing from the right abutment. Seepage was estimated to be approximately 5 gpm from each of the locations except at Sta. 2+90 where the seepage was estimated to be 20 gpm. All of the seep water, except that flowing from the right abutment, was reddish in color, indicating flow through a high iron content soil. None of the seepage appeared to be piping any material from the embankment or foundation. Seepage from the right abutment and at approximate Sta. 2+00 was used to fee a pond constructed at the toe of the dam near the right abutment (see Plate 3 and Photo 14). The pond is used to water stock and as a minnow pond. The pond follows the toe of the dam for approximately 75 feet and extended approximately 100 feet perpendicular to the dam. According to the owner the seepage began after the construction of the dam, but it has decreased approximately 80% during the life of the dam.

c. Appurtenant Structures. A vertical inlet constructed of 30-inch diameter, bituminous coated, corrugated metal pipe junctioned with a 24-inch diameter, bituminous coated, corrugated metal pipe is the primary means of discharge. A 54 inch diameter circular trash rack screen of welded rebar construction with a metal baffle mounted inside the trash rack (see Photo 9) was laying over the vertical inlet. The trash rack and 13 inches of the bituminous coated, corrugated metal pipe composing the drop inlet had been severed from the remaining portion of the drop inlet by a bulldozer clearing brush from the upstream slope of the dam. However, the owner said that he planned to repair the vertical drop inlet in the very near future.

The outlet pipe discharges into an earth stilling basin located approximately 98 feet downstream of the dam centerline (see Photo 10). The stilling basin is approximately 30 feet in diameter.

An earth, emergency spillway is cut in the left abutment. The spillway is a trapezoidal section with a 50-foot bottom width and side slopes of approximately 1V on 3.5 H. The spillway is partially blocked by trash and dead trees that were placed there by a bulldozer after clearing brush and debris from the upstream slope. Below the crest of the dam, erosion in the spillway outfall becomes severe with the depth of the spillway channel being greater than 8 feet (see Photo 12). The erosion continues throughout the length of the spillway outfall and terminates in a large hole at the base of the spillway outfall channel (see Photo 13). The spillway is approximately 100 feet long from the dam centerline.

d. Reservoir Area. No wave wash, excessive erosion or slides were observed along the shore of the reservoir.

e. Downstream Channel. The downstream channel is overgrown with trees and brush.

3.2 EVALUATION

None of the conditions observed are significant enough to indicate a need for immediate remedial action or a serious potential of failure. Visually observed seepage, blockage of the emergency spillway, severe erosion in the spillway outfall, and the continued growth of trees and large bushes on the downstream slope are deficiencies which left uncontrolled or uncorrected could lead to the development of potential problems.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The primary discharge system and emergency spillway are uncontrolled; therefore, no regulating procedures exist for these structures. The pool is controlled by rainfall, runoff, evaporation, and capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

The upstream slope and crest of the dam appear to be well maintained, but brush and small trees are growing extensively on the downstream slope. Trash and debris partially block the emergency spillway in the left abutment. Also, the trash screen, metal baffle, and 13 inches of the vertical drop inlet have been severed from the remainder of the drop inlet. The blockage of the emergency spillway and the severing of the vertical drop inlet occurred recently while clearing the upstream embankment of brush and debris. The owner said that these two conditions would be corrected in the near future.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing warning system for this dam.

4.5 EVALUATION

The maintenance of the dam appears adequate if the following operations are performed:

(1) The bushes and trees growing on the downstream embankment need to be cut.
(2) The damaged vertical drop inlet should be repaired.
(3) The trash and debris partially blocking the emergency spillway should be removed.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. The available hydraulic and hydrological design appears accurate and adequate for the intended purpose of the intial design.

b. Experience Data. The drainage area was developed using USGS Shook, Mo. Quadrangle. The lake surface area and storage values were comparable to the 1967 drawings furnished by the Soil Conservation Service. The spillway and dam layout are made from surveys conducted by the inspecting team. Comparisons were made with the 1967 drawings and the inspection surveys. All relative elevations are comparable with the elevations on the 1967 drawings. However, the emergency spillway is located in the left abutment instead of the right abutment.

c. Visual Observations.

(1) The earthen spillway is partially blocked by a pile of trash and debris placed there recently by a bulldozer after removing the brush and debris from the upstream slope (see Photo 11).

(2) The emergency spillway outfall is severely eroded approximately 20 feet downstream of the crest of the dam.

(3) The trash screen and 13 inches of the vertical drop inlet have been severed from the remainder of the drop inlet.

(4) The vertical shaft is located approximately 100 feet from the left abutment while the spillway is located in the left abutment. Releases from either structure will not endanger the integrity of the dam.

d. Overtopping Potential. The spillway will safely pass 25 percent of the Probable Maximum Flood (PMF) at a discharge of 1000 cfs without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be discharged from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The PMF will overtop the embankment for a period of 5 hrs at a depth of 2.0 ft with a discharge of 5800 cfs. The 1/2 PMF will also overtop the embankment for a period of 2 hrs at a depth of 1.0 ft with a discharge of 2800 cfs. The 100-year frequency flood will not overtop the embankment. For its size and hazard category, this dam is required by the guidelines to pass from one-half PMF to PMF. However, considering the high-hazard potential to life and property of approximately seven families downstream of the dam, the PMF is considered the appropriate spillway design. Because the spillway will not pass 1/2 PMF without overtopping but will pass the 10-year frequency flood, the dam is classified as unsafe non-emergency. The data utilized in the preparation of the estimates was various Federal reports, data from field inspection and survey, and output from COE program HEC-1, Dam Safety Version. More specific details will be found in Appendix A.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of the dams and spillway are discussed and evaluated in Section 3 and 5. The dams have no other appurtenant structures.

b. Design and Construction Data. The design and construction data were limited to that information discussed in SECTION 2.

c. Operating Records. There have been no known operations which have affected the structural stability of the dam.

d. Post Construction Changes. No post construction changes exist which will affect the structural stability of the dam.

e. Seismic Stability. This dam is located in Seismic Zone 2. However, it is located very near the boundary between Seismic Zones 2 and 3. Since this dam is located in Seismic Zone 2 and in the proximity of Seismic Zone 3, it is possible that an earthquake could occur of sufficient intensity to cause severe damage or failure of the dam.

SECTION 7 - ASSESSMENT/ REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. A few items were noted during the visual inspection by the inspection team which should be corrected or monitored. These items are detailed in paragraph 7.2 c. The Probable Maximum Flood (the spillway design flood) and one-half of the Probable Maximum Flood will both overtop the dam. Because the spillway will not pass one-half of the PMF without overtopping the dam but will pass the 10-year frequency flood, the dam is classified as "unsafe non-emergency."

b. Adequacy of Information. Due to the lack of engineering design and construction data, the conclusions in this report were based on performance history and external visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein.

c. Urgency. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item recommended in paragraph 7.2 a. should be pursued on a high-priority basis.

d. Necessity for Phase II. Based on the results of the Phase I inspection, no Phase II inspection is recommended.

e. Seismic Stability. This dam is located in Seismic Zone 2. However, it is located very near the boundary between Seismic Zone 2 and 3. Since this dam is located in Seismic Zone 2 and in the proximity of Seismic Zone 3, it is possible that an earthquake could occur of sufficient intensity to cause severe damage or failure of the dam.

7.2 REMEDIAL MEASURES

a. Alternatives. Spillway size and/or height of dam should be increased to pass the Probable Maximum Flood without overtopping the dam.

b. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record. The presence of the pond near the right abutment should be taken into account in performing the seepage and stability analyses.

c. O & M Maintenance and Procedures. The following O & M maintenance and procedures are recommended:

(1) Cut the bushes and trees growing on the downstream slope.

(2) Repair the downstream slope where a gulley has formed near the left abutment.

(3) Repair the small erosion gulley in the right abutment near the crest of the dam.

(4) The downstream slope and toe should be closely monitored for seepage and erosion. If seepage quantities and/or erosion observed during monitoring indicate increases or signs of material being piped from the embankment, immediate action should be taken to rectify these conditions.

(5) Protective measures should be taken to prevent further erosion in the spillway outfall channel.

(6) The trash and debris partially blocking the emergency spillway should be removed immediately.

(7) The damaged vertical drop inlet should be repaired immediately.

(8) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

APPENDIX A

Hydrology and Hydraulic

1. Narrative. The methods and sources of data were primarily those suggested by the Hydraulics Branch, St. Louis District Corps of Engineers. Specific references and methods will be discussed below. A field inspection survey was made to determine the outlet structures and the topographic characteristics of the dam. HEC-1, Dam Safety Version was used in conjunction with appropriate input parameters to compute inflow hydrographs, determine storage, and route through the structure.

a. Rainfall. The PMF was developed using Hydrometeorological Report No. 33. The "Hop Brook" reduction factor was not used to adjust the rainfall for this study. The distribution of rainfall was developed using the criteria as described by EM 1110-2-1411 (Standard Project Storm).

PMF Rainfall	27.2 in
PMF Percentages	6 hr - 102
	12 hr - 120
	24 hr - 130

b. Unit Hydrograph Coefficients. The unit hydrograph for the drainage basin was developed using the Snyder Method as outlined in HEC-1, Dam Safety Version. Two methods of determining time of concentration were used, namely the Snyder's method and Kirpich method.

The variables used for the appropriate method are listed below.

Snyder's : $t_p = C_t\ (L\ L_{cg})^{0.3}$; L and L_{cg} in miles

L = 7000 feet = 1.33 miles

L_{cg} = 1700 feet = 0.32 miles

Stream Slope = 122 ft/mi. = .023 ft/ft

C_t = .56

tp = .42 hr

t_c = .50 hr

Kirpich $t_c = .00013 \left(\frac{L \text{ ft}}{\sqrt{\text{SLOPE, ft/ft}}} \right)^{.77}$

t_c = .50 hr

Where L = length of the main stream channel from the outlet to the divide

L_{cg} = length along the main channel to a point opposite the watershed centeroid.

C_t = coefficient used in Snyder's method

t_p = time to peak (hr)

t_c = time of concentration (hr)

Consequently, since the time of concentrations agreed so closely, a value for t_p was chosen to be .42 hr or 25 minutes which necessitated developing a 5-minute unit hydrograph and applying only a 24 hr rainfall to develop the inflow hydrographs.

The general soils map of Wayne County indicates that Lottes Dam lies in an area where the soil is of the Clarksville Association which is gently sloping to moderately steep soils that have loamy subsoil with a fragipan. This places the area in a Soil Group B. The primary soil cover consists of woods in a fair hydrologic condition which gives a value of CN of 78 for antecedent moisture condition III. Consequently a value of C_p = .65 was chosen as the runoff parameter to be used in Snyder's method.

Listed below are the remaining parameters necessary to develop the unit hydrograph of 5-minute duration.

$C_p = .650$

Drainage Area = .747 sq. mi.

The unit hydrograph ordinates are found in the computer printout.

c. Loss Rates. A loss rate of .5 in. initially and .05 in./hr. was chosen based upon engineering experience.

d. Base Flow and Antecedent Flood Conditions. A base flow of 1 cfs was selected and the routing was started at the low point in the spillway crest of 537.3 m.s.l.

e. Hydrograph Routing. HEC-1, Dam Safety Version uses the single routing step of the "Modified Puls" method. Routing through the emergency spillway and over the embankment was accomplished using the non-level dam top option of the HEC-1, Dam Safety Version (see Plate 3) coupled with critical energy consideration of the flow. The routing through the drop inlet structure was obtained considering pipe full conditions with the following assumptions:

Vertical Pipe	Horizontal Pipe
D = 30 inch CMP	D = 24 inch CMP
L = 10 feet	L = 130 feet
n = .025	n = .025

head losses: $h_{ent} = .5 \frac{V_{30}^2}{2g}$

$h_{bend} = 1.1 \frac{V_{30}^2}{2g}$

$h_{exit} = \frac{V_{24}^2}{2g}$

h_f = friction loss in 30 inch and 24 inch pipe, respectively

$Q = .3588\ A_{24"} \sqrt{2g}\ H^{1/2}$

The invert elevation from which to calculate H, height of head, is 508.7 m.s.l.

f. Storage. The storage was calculated with the HEC-1, Dam Safety Version with input consisting of elevations and respective surface area which were determined using the USGS Shook quadrangle.

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************
     1              A                      NON-FEDERAL DAM INSPECTION
     2              A                                DAM #30309
     3              A                                LOTTES DAM
     4              B    300       0       5      -0      -0      -0      -0      -0      -0      -0
     5              B1     5
     6              J      1       4       1
     7              J1    .1     .15     .20     .25     .27     .30     .35     .50      1.
     8              K      0       1                                       1
     9              K1             PROBABLE MAXIMUM PRECIPITATION-24 HR DURATION
    10              M      1       1   .7469           .7469      1.
    11              P           27.2     102     120     130
    12              T                                                     .5     .05
    13              W    .42    .650
    14              X      1       1       2
    15              K      1       2                                       1
    16              K1                     ROUTED FLOWS THROUGH LOTTES DAM
    17              Y                              1       1
    18              Y1     1                                          -537.3
    19              SA     0   3.936  25.735  53.891
    20              SE   500     520     540     560
    21              SS 537.3                           508.7   .3588   3.142      .5
    22              SD 541.0
    23              SL     0      50      67     193     443     576
    24              SV 537.3   538.5   540.3   541.0   541.0   559.6
    25              K     99
```

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE: 15 AUG 79
     TIME: 08.48.50
```

NON-FEDERAL DAM INSPECTION
DAM #30509
LUTTES DAM

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	5	=0	=0	=0	=0	=0	=0	=0
			JOPER	NRT	LROPT	TRACE			
			5	=0	=0	=0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS=	.10	.15	.20	.25	.27	.30	.35	.50	1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

PROBABLE MAXIMUM PRECIPITATION-24 HR DURATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	=0	=0	=0	=0	1	=0	=0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.75	=0.	.75	1.00	=0.	=0	=0	=0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
=0.	27.20	102.00	120.00	130.00	=0.	=0.	=0.

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
=0	=0.	=0.	1.00	=0.	=0.	1.00	.50	.05	=0.	=0.

UNIT HYDROGRAPH DATA
TP= .42 CP= .65 NTA= =0

RECESSION DATA
STRTQ= 1.00 QRCSN= 1.00 RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.98 AND R= 8.12 INTERVALS

UNIT HYDROGRAPH 26 END-OF-PERIOD ORDINATES, LAG= .42 HOURS, CP= .65 VOL= 1.00

61.	219.	425.	614.	758.	786.	683.	504.	305.	310.
245.	190.	144.	117.	91.	72.	56.	44.	35.	27.
21.	17.	13.	10.	8.	6.				

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1 .10	RATIO 2 .15	RATIO 3 .20	RATIO 4 .25	RATIO 5 .27	RATIO 6 .30	RATIO 7 .35	RATIO 8 .50	RATIO 9 1.00
HYDROGRAPH AT	1	.75 (1.93)	1	616. (17.43)	923. (26.15)	1231. (34.86)	1539. (43.58)	1662. (47.06)	1847. (52.29)	2155. (61.01)	3078. (87.16)	6156. (174.31)
ROUTED TO	2	.75 (1.93)	1	179. (5.08)	455. (12.90)	721. (20.42)	1004. (28.42)	1133. (32.07)	1372. (38.86)	1745. (49.41)	2776. (78.62)	5826. (164.98)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	537.30	537.30	541.00
STORAGE	227.	227.	317.
OUTFLOW	48.	48.	1085.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	538.79	0.	261.	179.	0.	17.42	0.
.15	539.74	0.	285.	455.	0.	16.58	0.
.20	540.41	0.	302.	721.	0.	16.42	0.
.25	540.89	0.	315.	1004.	0.	16.33	0.
.27	541.05	.05	319.	1133.	.25	16.33	0.
.30	541.23	.23	324.	1372.	.58	16.25	0.
.35	541.45	.45	330.	1755.	.92	16.17	0.
.50	541.93	.93	343.	2776.	1.67	16.08	0.
1.00	543.00	2.00	374.	5826.	5.08	16.08	0.

APPENDIX B

Geology of Damsite

General Geology. The following geologic information was obtained from a search of the very limited available literature, one field inspection of the site and the Shook quarry, (2.5 miles southeast of Lottes Dam) and core borings taken recently by the Memphis District Corps of Engineers in connection with a subsurface investigation of the Wappapello Dam (10 miles southeast of the Lottes Dam).

Field investigations conducted at Lottes Dam did not reveal any rock outcrops within the local vicinity of the dam. Other investigations as mentioned earlier indicate the dam to be founded on 60 to 140 feet of residuum material underlain by crystalline dolomite of the Gasconade formation of the Ordovician System.

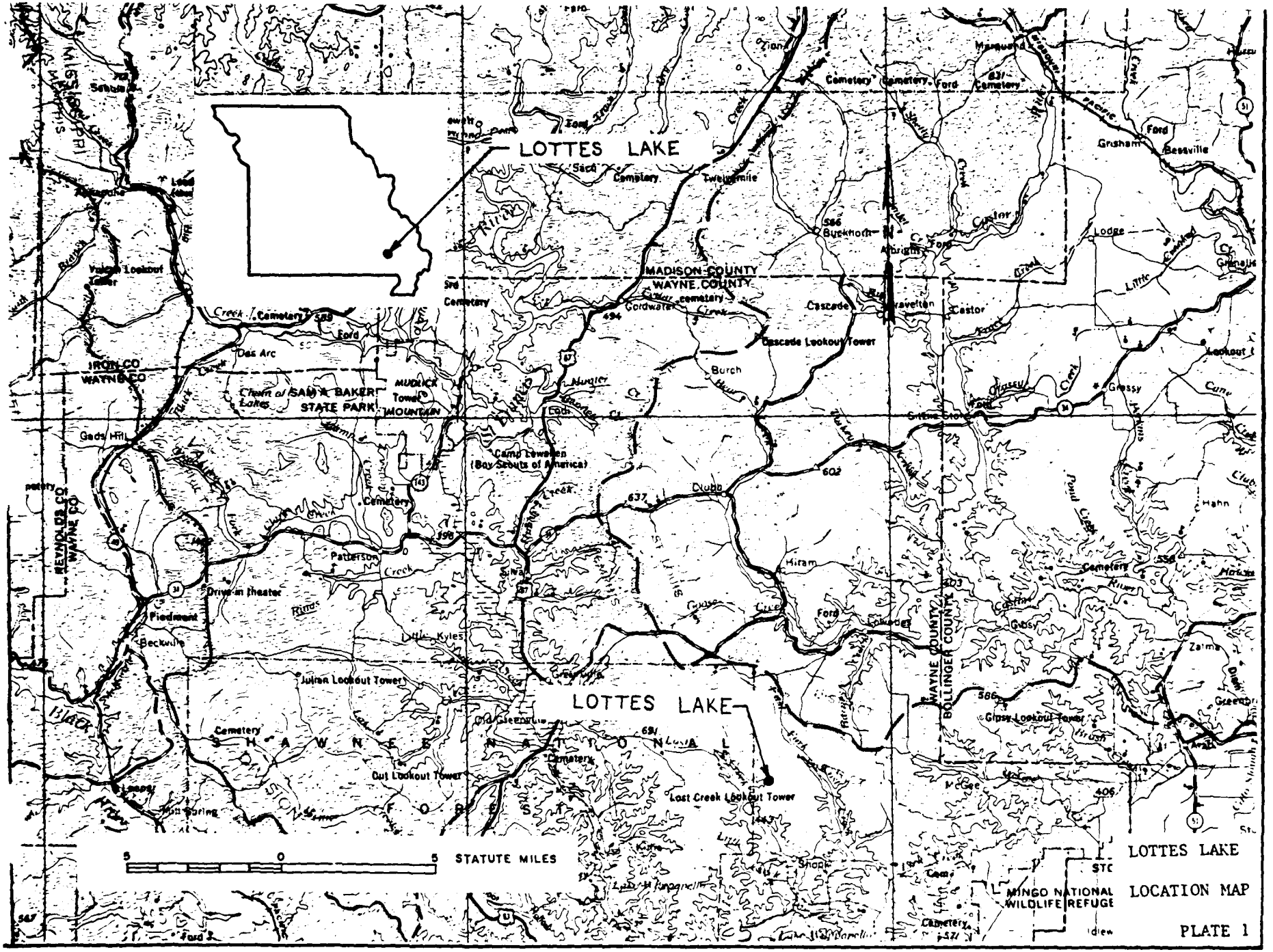
Subsurface investigations at Wappapello Dam indicate 60 to 140 feet of residuum material underlain by crystalline rock. The residuum is composed of red clay with sand and rock fragments of limestone, dolomite and chert. A light tan to gray, medium to coarsely crystalline dolomite with numerous vuggy zones and inclusions of yellow to tan chalky chert were found beneath the residuum. The formation is believed to be the Roubidoux and contains zones of dolomitic limestone and dolomitic sandstone. The top 30 to 35 feet of this formation contained zones that were highly fractured with numerous solution cavities. The Roubidoux was found to vary in thickness from 60 to 80 feet with the base of the formation being fairly confident rock with minor fractures and vugs. At the base of the Roubidoux black shale partings underlain by a lense of siltstone were found. The underlying rock was very similar to the Roubidoux but believed to be the Gasconade formation. It consisted of tannish gray and gray mottled medium crystalline dolomite containing numerous irregular styblites and pink calcite inclusions. Several lenticular zones of sandstone, dolomitic sandstone and cherty dolomite were found in the top 100 feet of this formation. Vuggy zones existed that were partly filled with tan stained calcite. Predominately this formation is sound rock with only a few fractured zones.

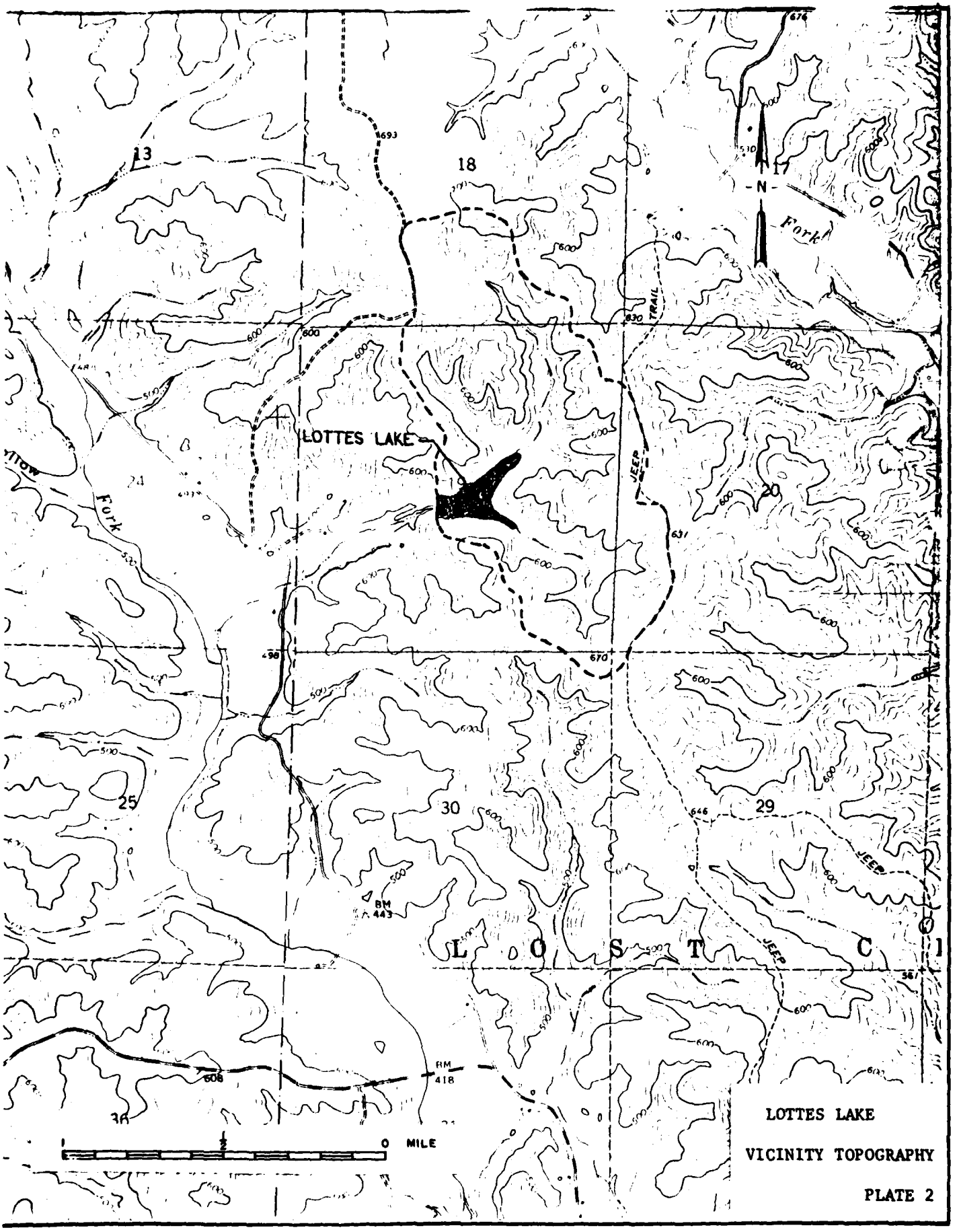
Field investigations at the Shook quarry indicate about 100 feet of residuum material. It had been stripped off during the quarry operation and was impossible to determine the exact thickness. The residuum was underlain with dolomite believed to be the Gasconade formation.

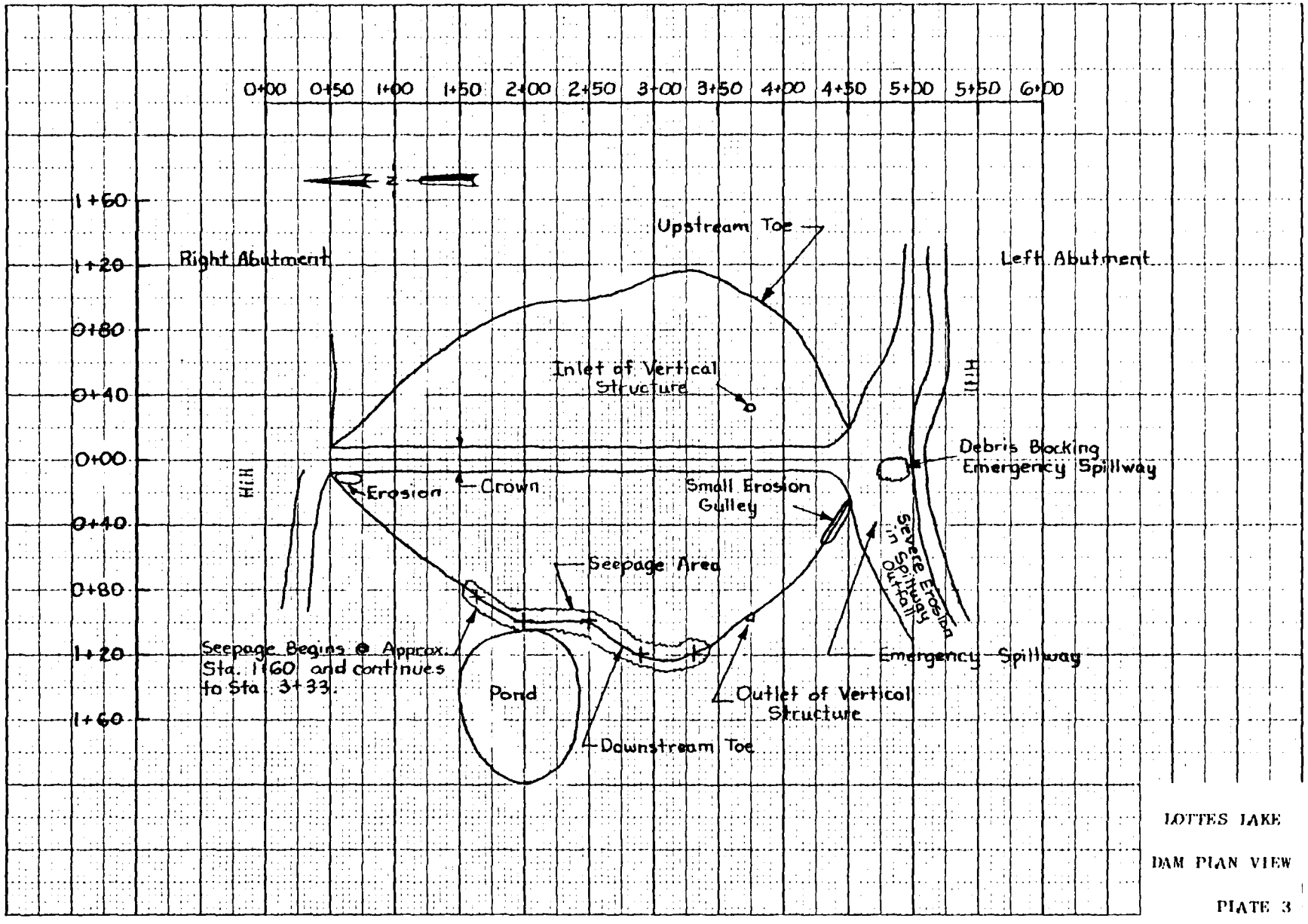
Regional structure of the area is controlled somewhat by the Mississippi Embayment, a southerly plunging syncline whose axis is basically outlined by the course of the Mississippi River. The regional dip of the beds is about 1 to 2 degrees toward the Mississippi Embayment.

Two major joint systems are present in this area. One system runs northwest to southeast and a second northeast to southwest with vertical fractures. A minor joint system exists in the North-South and East-West directions. The topography and stream patterns of the area are greatly influenced by these joints. Solutions zones were found to exist along joints and bedding planes. Caves and sink holes of various sizes are numerous in some areas of the Roubidoux and the Gasconade which are a direct result of solution activity.

Site Description. Lottes dam is situated in a narrow valley surrounded by hills with steep slopes. The valley drainage served as a minor tributary to West Fork Creek prior to dam construction. The maximum relief in the valley is about 120 feet. The embankment, abutment and foundation material are predominately the same material, consisting of residuum. It is composed of red clay with sand and rock fragments. Several blocks of cherty dolomite and limestone were found on the left abutment looking downstream. The thickness of the residuum at the dam site may range from 60 to 140 feet in thickness. Considering other investigations and the regional structure, the residuum is probably underlain by a dolomite or dolomitic limestone of the Gasconade formation. The top 30 feet of which probably exist as a weathered surface with solution cavities and highly fractures zones. Seepage was observed at the downstream toe of the dam. This seepage was red in color and contained iron oxide precipitate. No other hazardous features such as soft seams, expansive clays or other geologic irregularities were noted. However, the lake is located within the Seismic Risk Zone 2 but very close to the Seismic Risk Zone 3. Because of its location in Seismic Risk Zone 2 coupled with the steep natural topography, there is a possibility of a sudden landslide into the lake during an earthquake.


LOTTES LAKE
MADISON COUNTY
WAYNE COUNTY
IRON CO
WAYNE CO
REYNOLDS CO
WAYNE CO
BOLLINGER COUNTY
SAM A BAKER STATE PARK
MUDLICK MOUNTAIN
Camp Lowaden (Boy Scouts of America)
Cascade Lookout Tower
Julian Lookout Tower
Out Lookout Tower
Lost Creek Lookout Tower
Gipsy Lookout Tower
Drive-in Theater
Piedmont
Patterson
Burch
Cascade
Hiram
Zalma
Gipsy
Grassy
Grisham
Beesville
Lodge
Castor
Hahn
Shook
Gads Hill
Dubb
Buckhorn
Twelvemile
Sacra
Cemetery
Ford
Creek
River
5 0 5 STATUTE MILES
LOTTES LAKE
LOCATION MAP
MINGO NATIONAL WILDLIFE REFUGE
PLATE 1

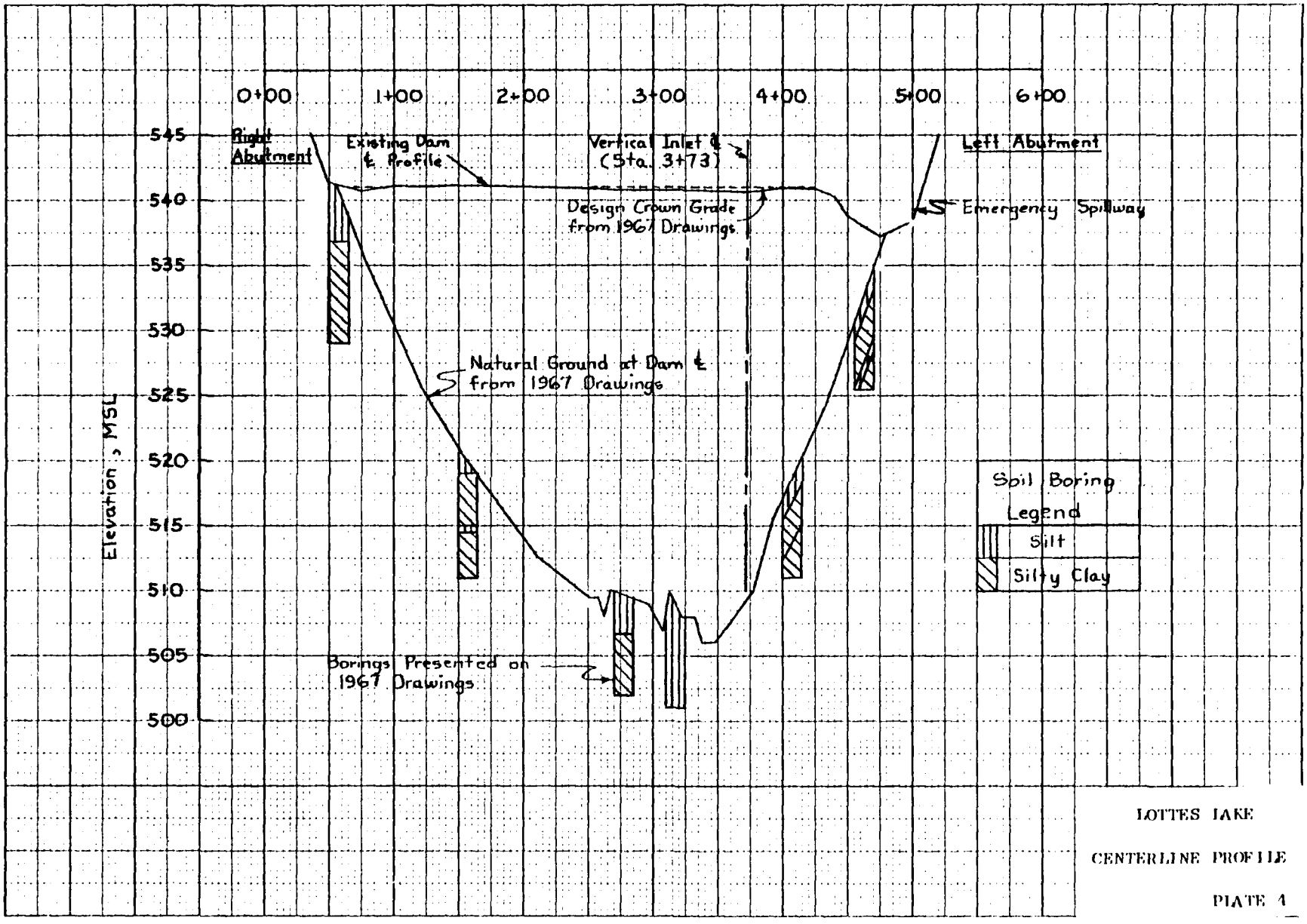

LOTTES LAKE
13
18
17
19
20
24
25
30
29
N
Fork
TRAIL
JEEP
JEEP
JEEP
BM
443
BM
418
608
670
631
L O S T C
0 MILE
LOTTES LAKE
VICINITY TOPOGRAPHY
PLATE 2



LOTTES LAKE

DAM PLAN VIEW

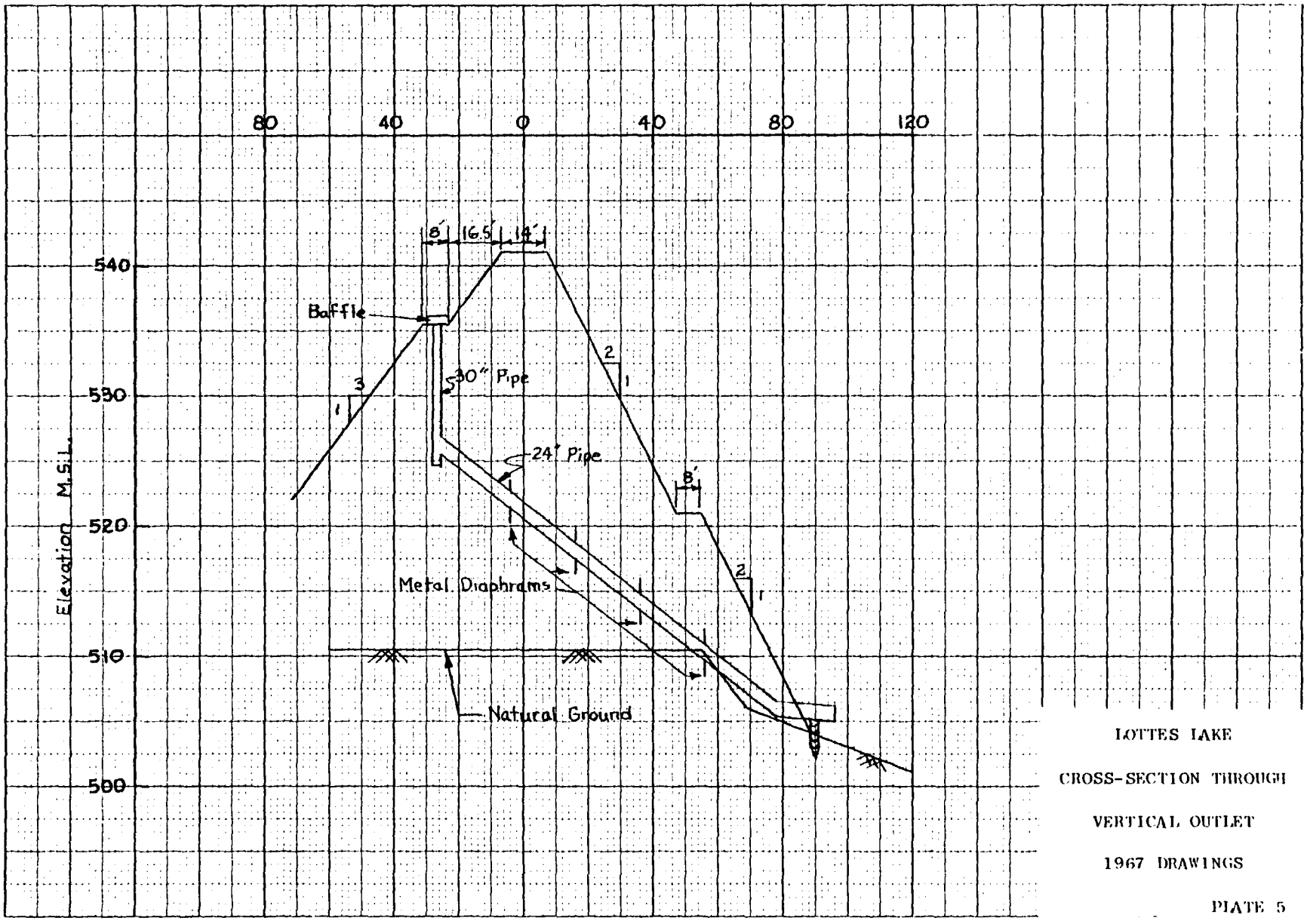
PLATE 3



LOTTES LAKE

CENTERLINE PROFILE

PLATE 4



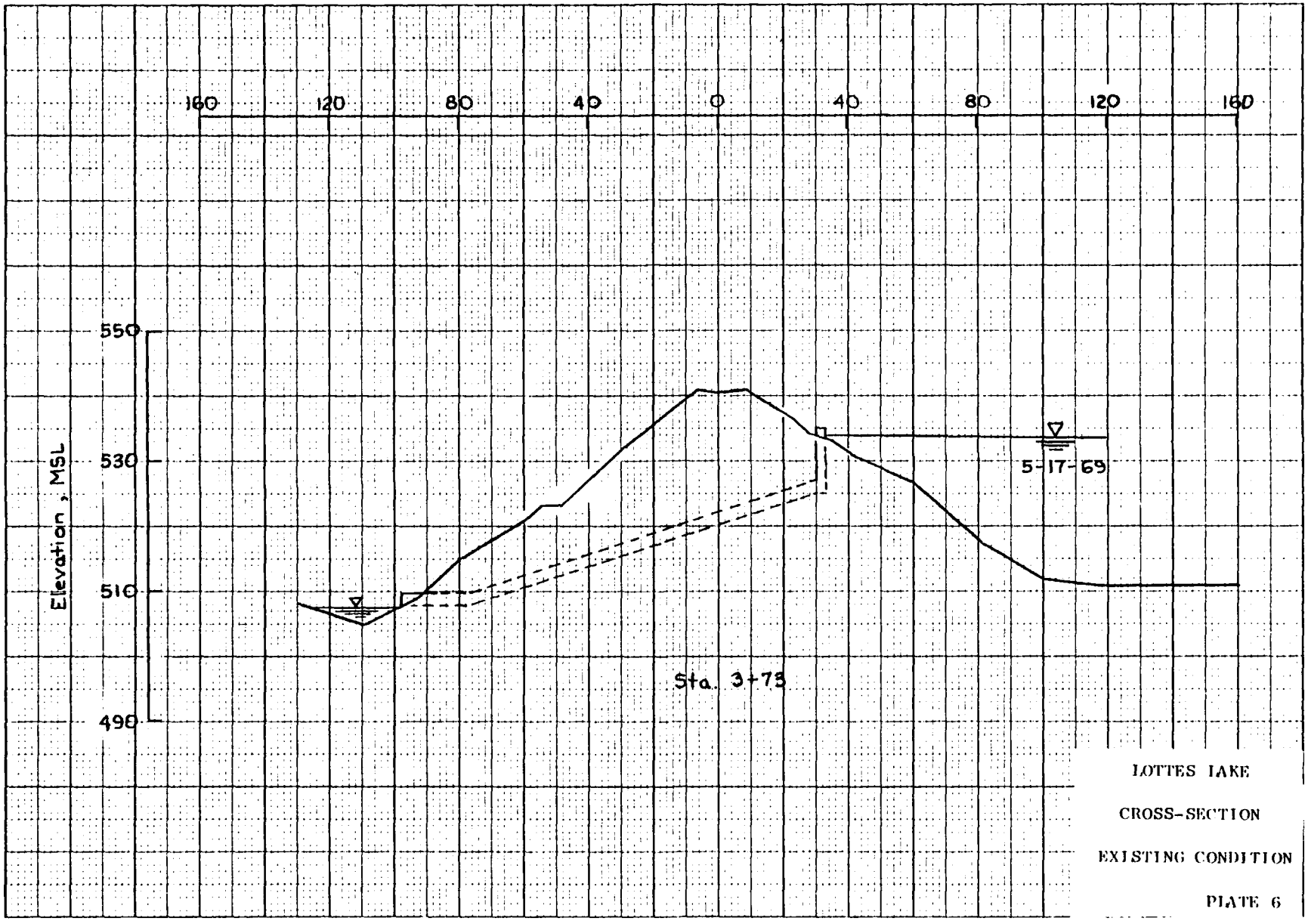
LOTTES LAKE

CROSS-SECTION THROUGH

VERTICAL OUTLET

1967 DRAWINGS

PLATE 5



LOTTES LAKE

CROSS-SECTION

EXISTING CONDITION

PLATE 6

PHOTO 1: Crest of Dam

PHOTO 2: Overview of Lake

PHOTO 3: Upstream Slope

PHOTO 4: Downstream Slope

PHOTO 5: Erosion Gully in Left Abutment

PHOTO 6: Growth on Downstream Slope

PHOTO 7: Seepage at Downstream Toe

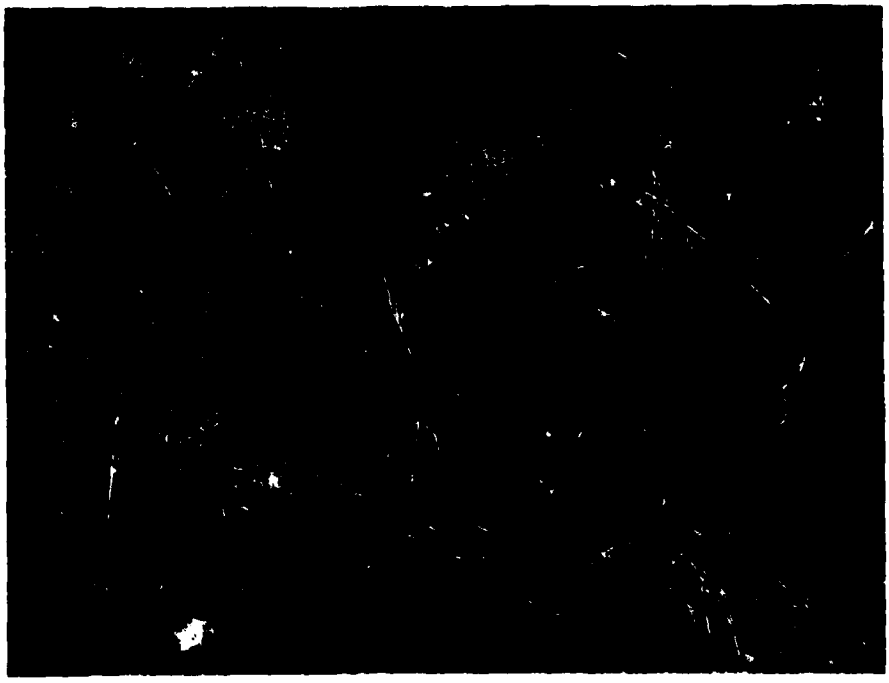


PHOTO 8: Seepage in Right Abutment

PHOTO 9: Inlet of Vertical Discharge

PHOTO 10: Discharge of Vertical Structure

PHOTO 11: Trash Blocking Emergency Spillway

PHOTO 12: Erosion in Spillway Outfall

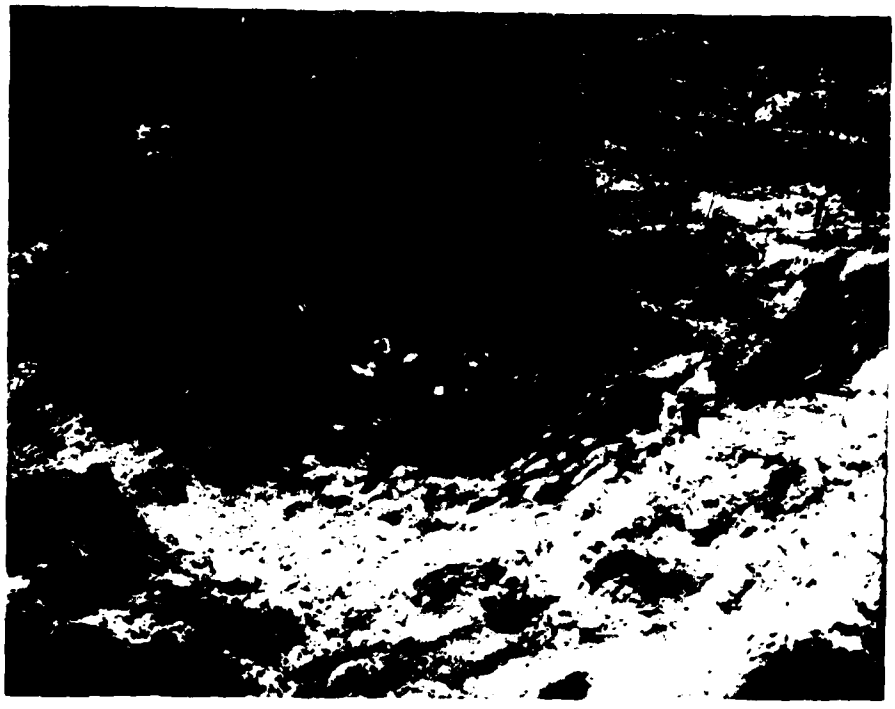


PHOTO 13: Deep Hole at Base of Spillway Outfall

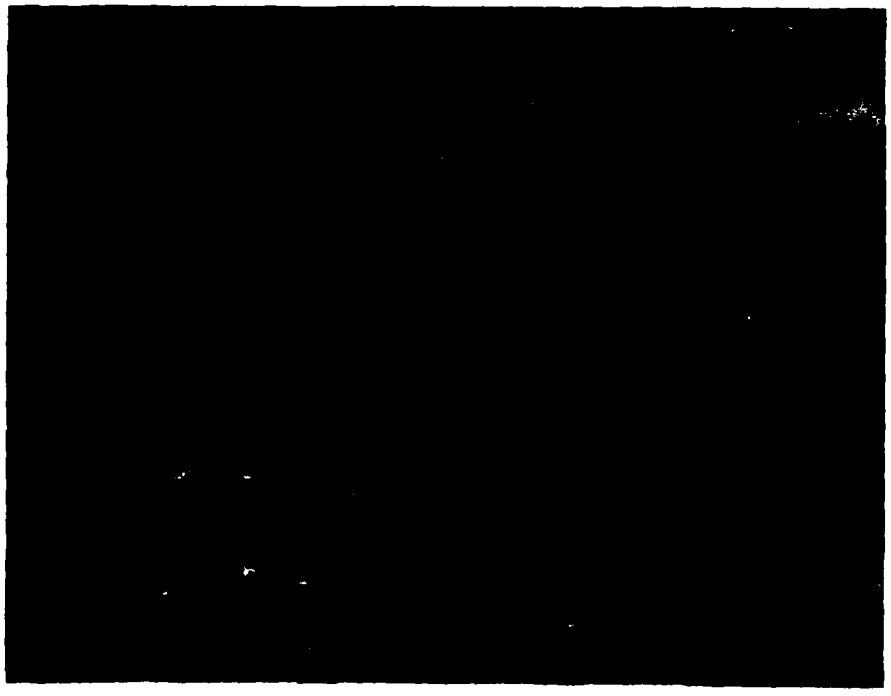


PHOTO 14: Pond Below Dam

PHOTO 15: Dwelling Downstream of Dam

PHOTO 16: Wash Area in Right Abutment


DATE
ILME